

Simulation of natural variability and extreme weather and climate events with the ARTS-ESM-M Earth system model

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ARTS-ESM-M Earth system model

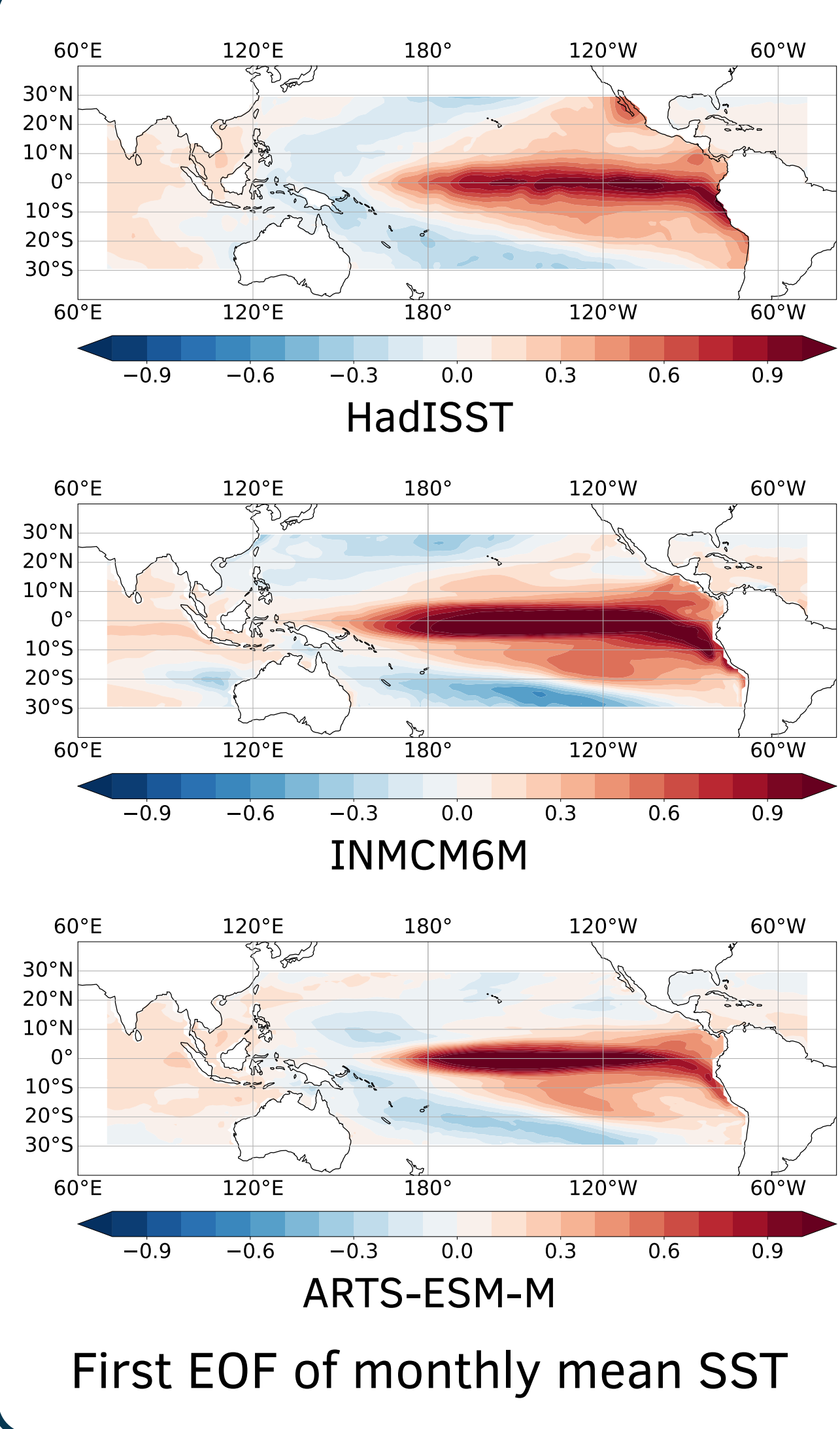


ARTS-ESM is a new generation of the INMCM family. ARTS-ESM-M is

- an evolution of the previous INMCM6M version (2024)
- planned to participate in the CMIP7 experiments (DECK, ScenarioMIP)
- a basis for seasonal and decadal prediction systems

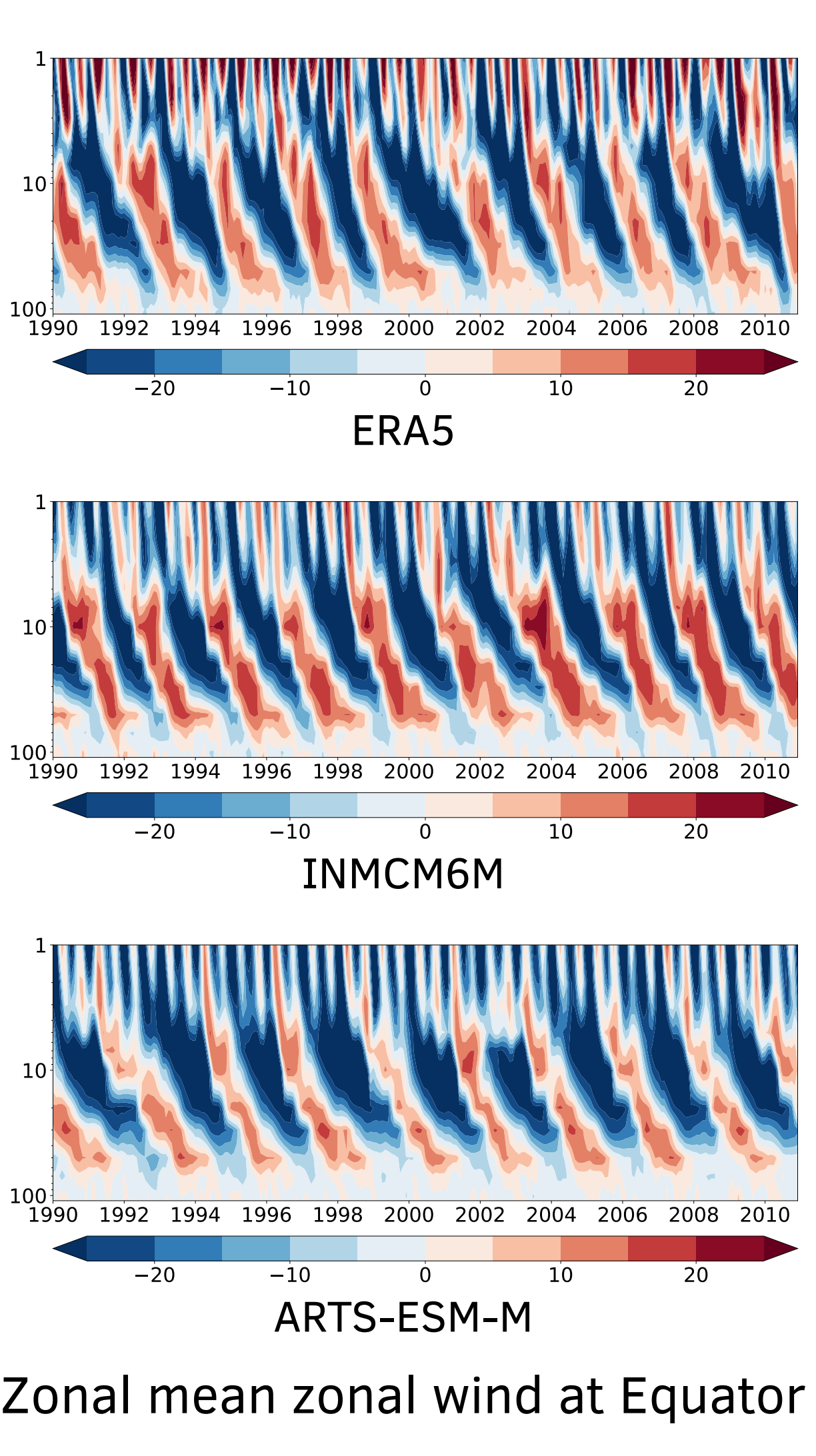
Modes of natural climate variability

El Niño–Southern Oscillation

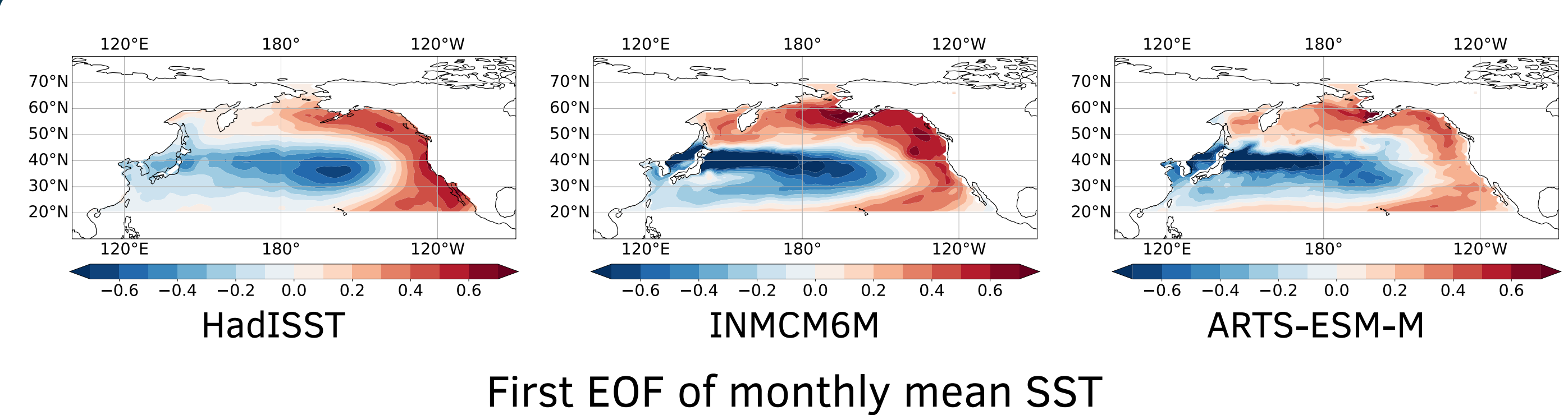


- ARTS-ESM-M reproduces negative SST anomalies in the western Pacific
- ARTS-ESM-M has better amplitude and period of the QBO than INMCM6M

Quasi-Biennial Oscillation

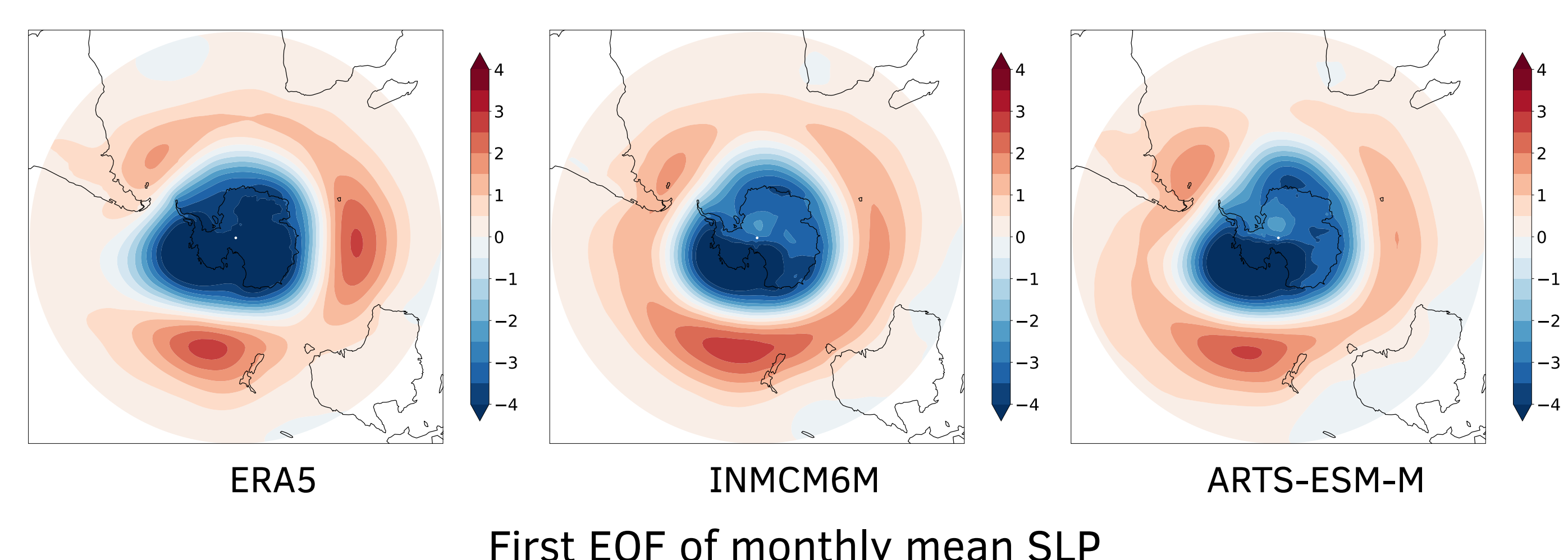


Pacific Decadal Oscillation



- Both models correctly reproduce the PDO pattern, but the SST anomaly minimum is shifted toward the Kuroshio

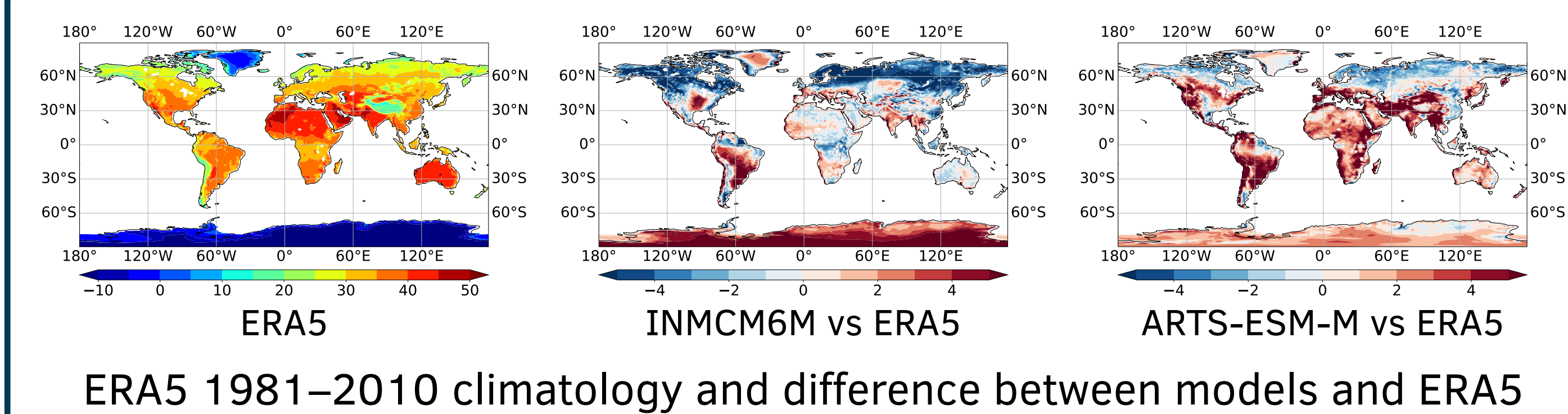
Southern Annular Mode



- Both models correctly capture the SAM minimum over West Antarctica, but underestimate the minimum over East Antarctica
- ARTS-ESM-M better reproduces the shape of the Amundsen Sea Low and separates the high-pressure centers east of New Zealand and over South America

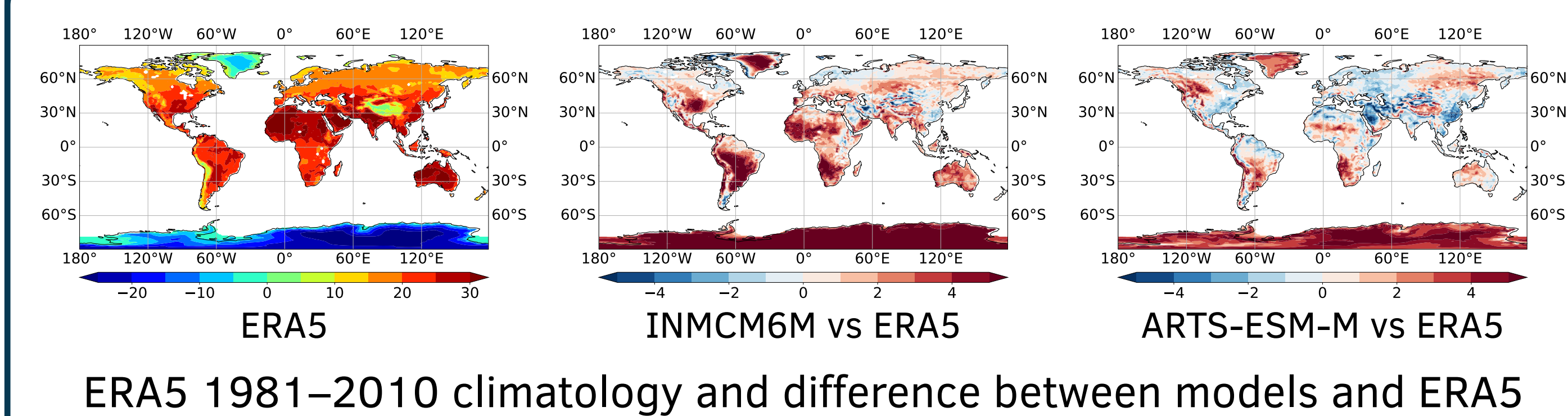
Climate extreme indices

Max of daily maximum temperature (TXx, °C)



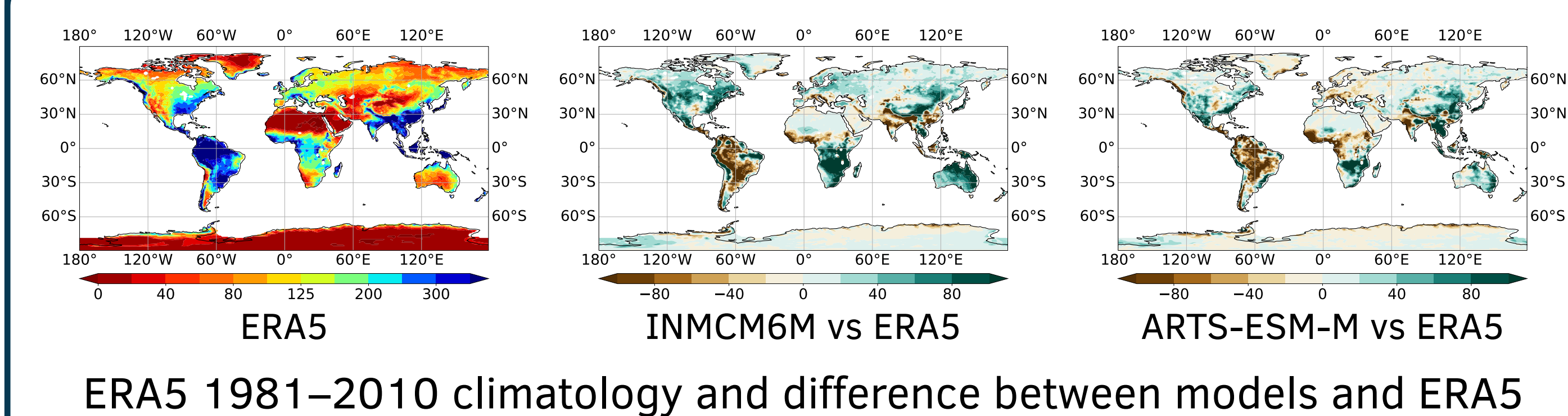
- ARTS-ESM-M reduces the underestimation of the TXx in the forested areas of the Northern America and the Northern Eurasia
- ARTS-ESM-M also reduces the overestimation of the TXx over Antarctica and Greenland

Max of daily minimum temperature (TNx, °C)

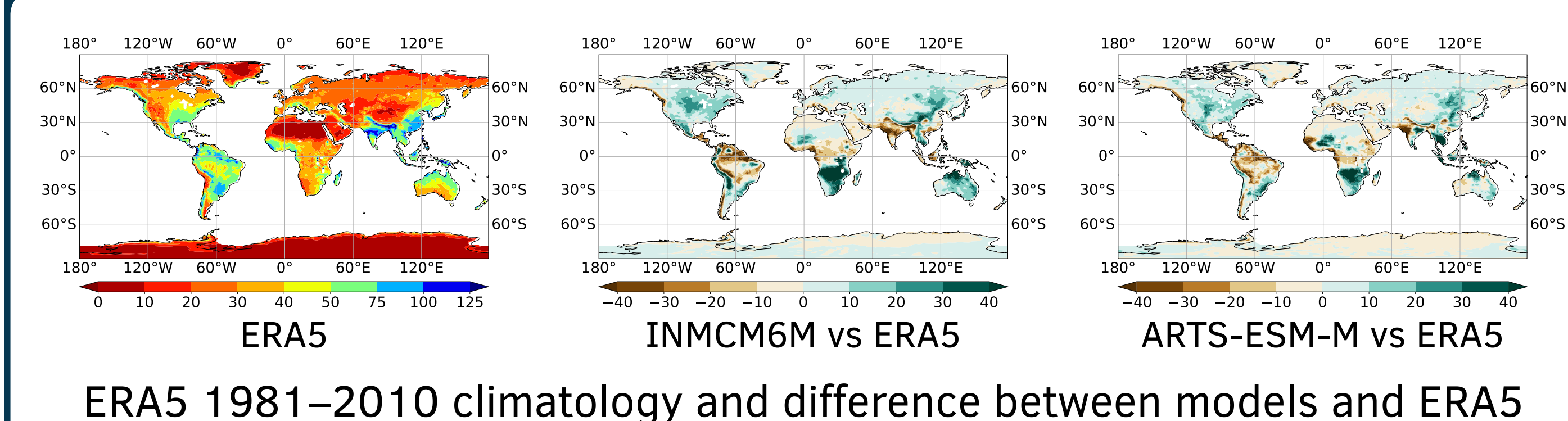


- The TNx model bias is reduced uniformly over land in ARTS-ESM-M compared to INMCM6M

Very wet days (R95p, mm)



Max 1 day precipitation (RX1day, mm)



- The R95p and RX1day overestimation over North America, South Africa and Australia is reduced by ARTS-ESM-M compared to INMCM6M
- ARTS-ESM-M also reduces the RX1day bias over South America

Conclusions

- ARTS-ESM-M outperforms INMCM6M in simulating natural climate variability phenomena like ENSO and QBO, which is essential for using the model in seasonal forecasts
- Notable improvements have been made in simulation of the extreme temperature and precipitation events using ARTS-ESM-M

Acknowledgments

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? Questions



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